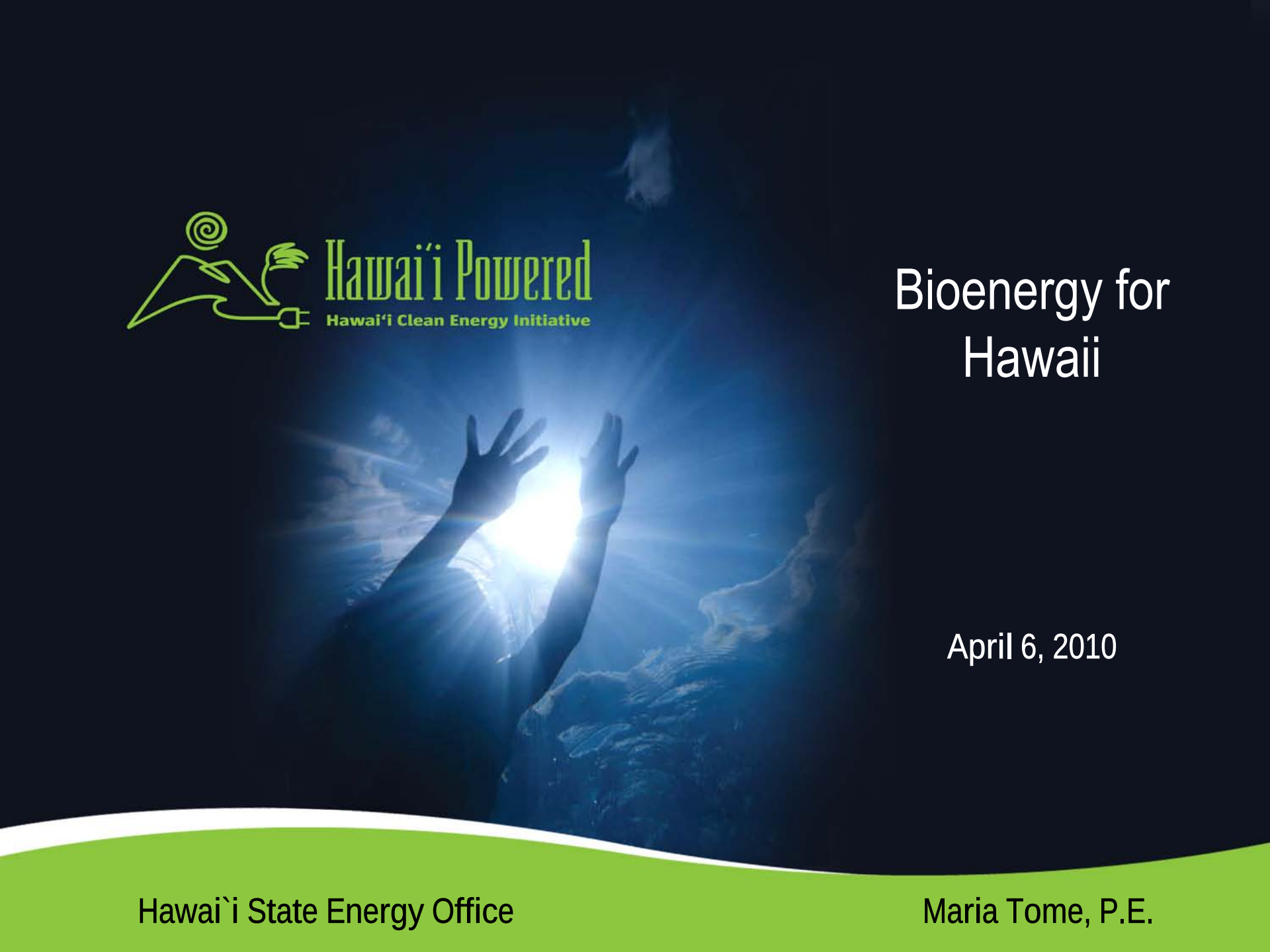


Bioenergy for Hawaii

April 6, 2010

Hawai`i State Energy Office

Maria Tome, P.E.

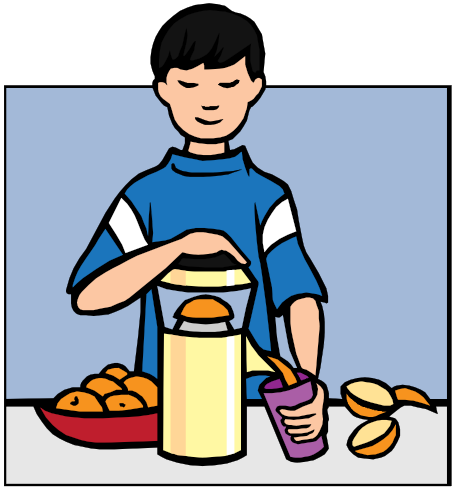
Contents

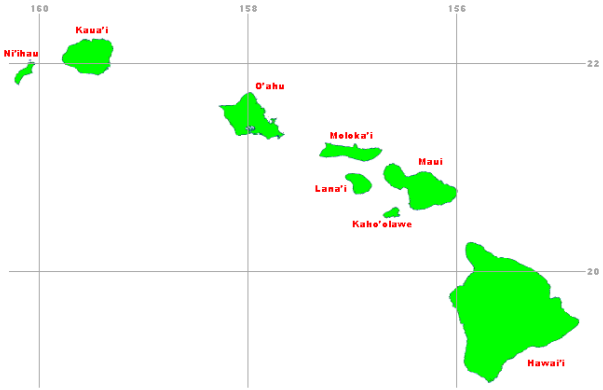
- Hawaii's Energy Challenge
- Pieces of the Energy Puzzle
- One piece: Bioenergy
  - Biofuels Assessment
  - Bioenergy Master Plan
- Summary

The Magnitude of the Challenge

50,000,000	barrels per year imported to Hawaii
1,300,000	resident population
38.46	barrels per resident per year
42	gallons per barrel
1615	gallons per resident per year
365	days per year
4.4	gallons per resident per day

How much energy is this?





Person

2,000	Calories / day
7,937	Btu / day
365	Days / year
2,896,874	Btu / year

1

Car

500	Gal. gasoline per year
110,000	Btu / gallon
55,000,000	Btu / year

19

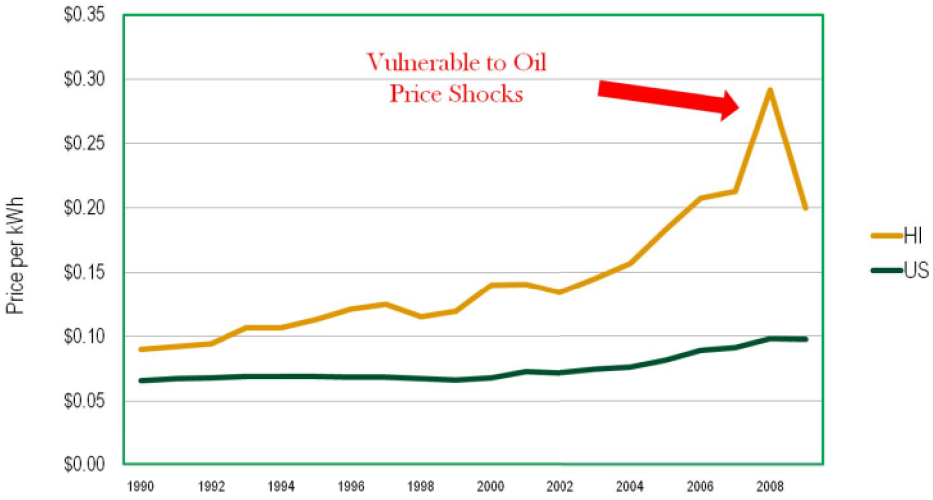
Hawaii's Economy

50,000,000	Barrels / yr
5,800,000	Btu per barrel
1,300,000	Res. pop.
223,076,923	Btu / year / person in HI economy

77

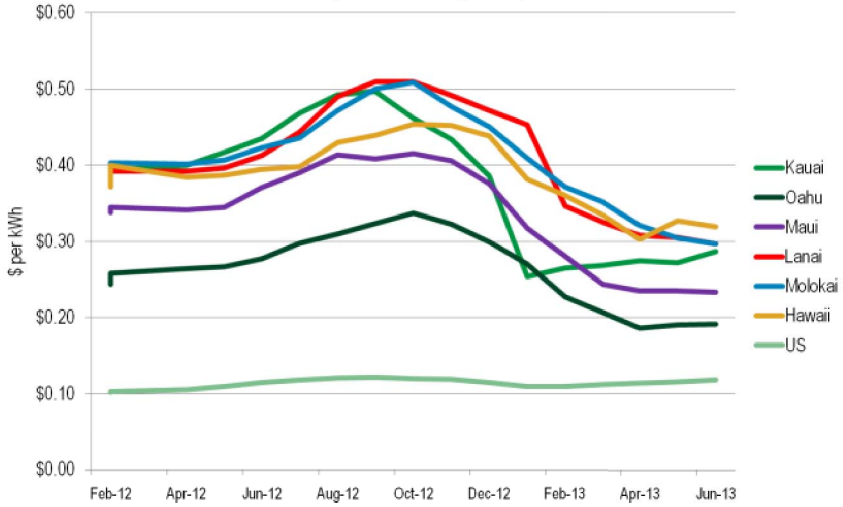
US and Hawaii Average Retail Price All Sectors per kWh

1990 through August 2009

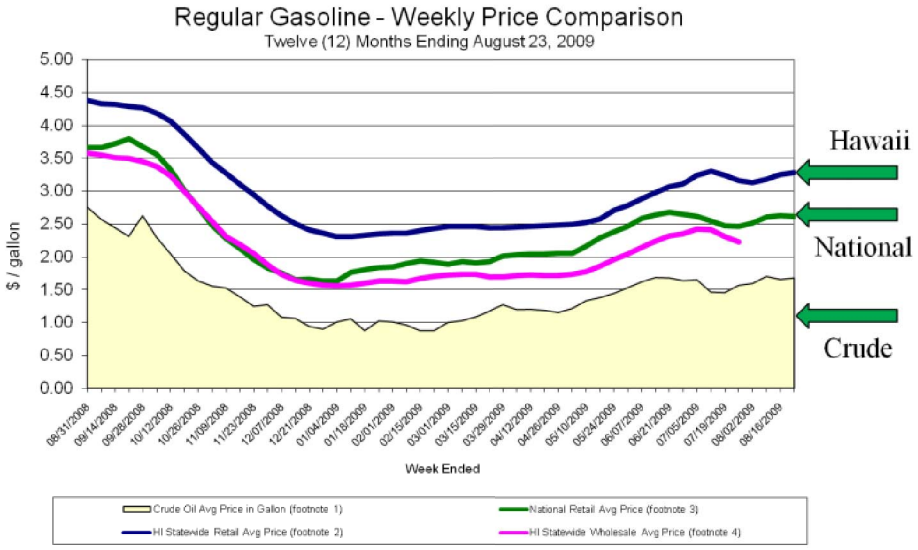


US and Hawaii Residential Price of Electricity

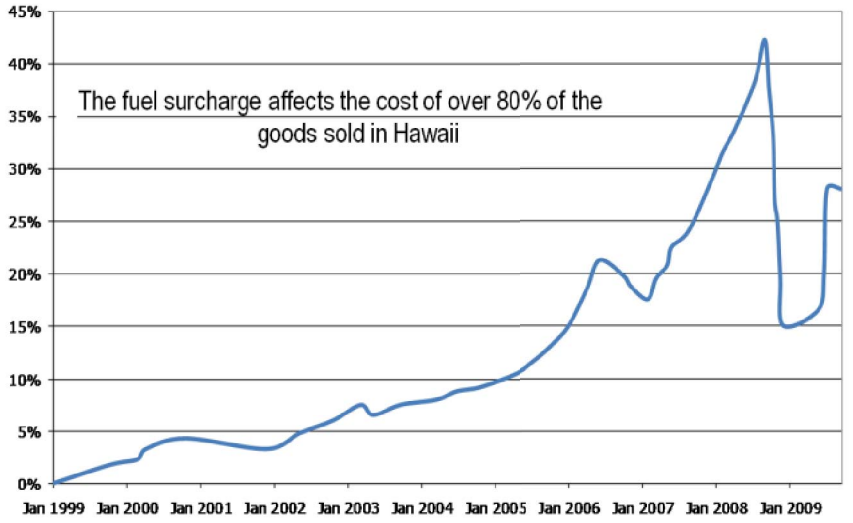
January 2008 through May 2009



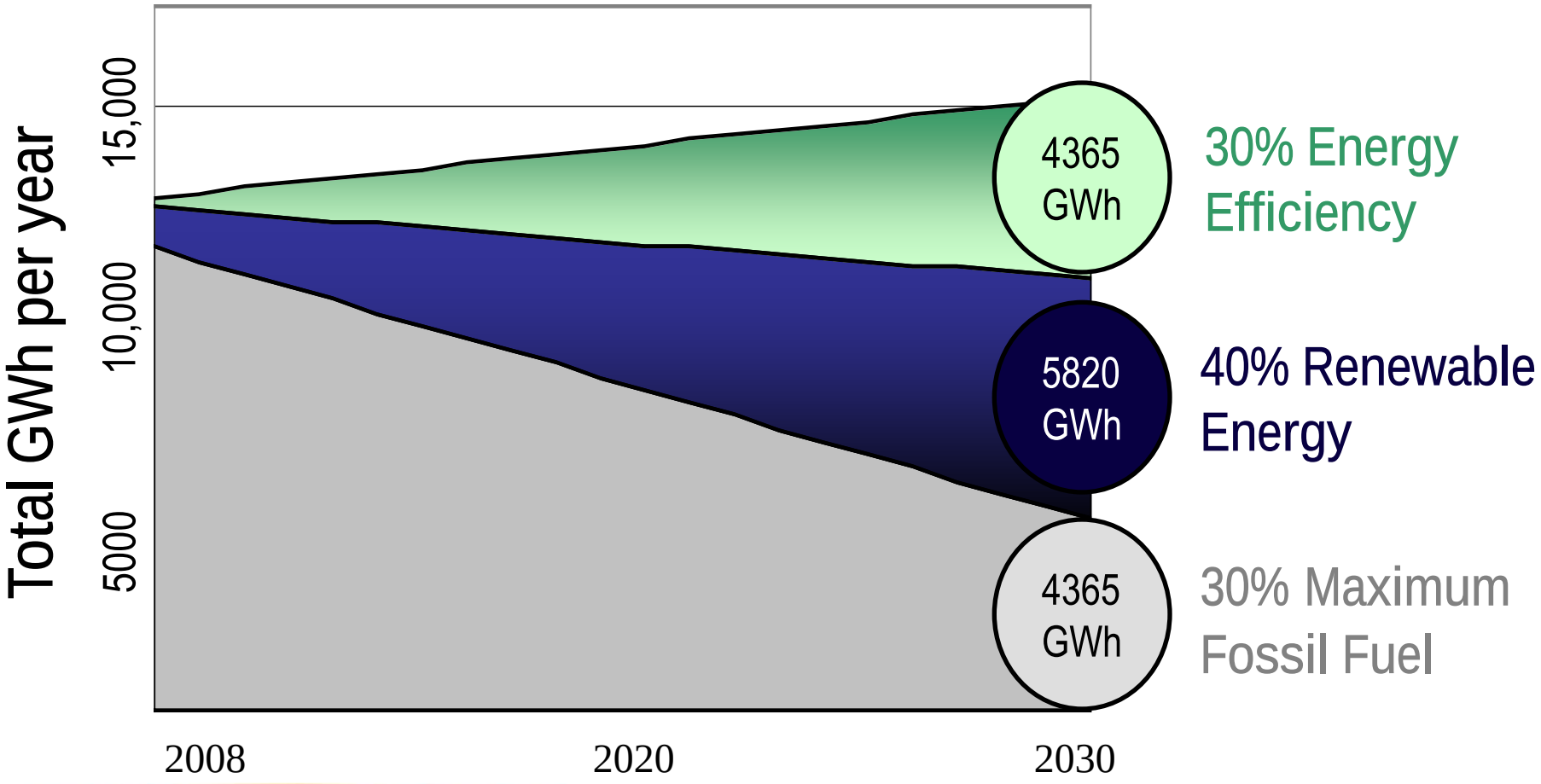
Hawaii's gasoline prices are among the highest



High energy costs multiply throughout the economy



Hawaii Clean Energy Initiative:
70% clean energy by 2030
from Efficiency (30%) + Renewables (40%)



Hawai'i Powered
Hawai'i Clean Energy Initiative

Energy for Tomorrow

Transportation

- Reduce Need to Travel (Land Use)
- Transportation System Design
  - Congestion Reduction
  - Alternative Modes
- More Efficient Vehicles
- Vehicles Capable of Using Non-petroleum Energy Sources
- Alternative Fuels & Fueling Infrastructure
  - Liquid fuels
    - Ethanol, Renewable Gasoline
    - Biodiesel, Renewable Diesel
    - Biojet
  - Electricity from renewable sources, off-peak
  - Gaseous Fuels (Hydrogen, Methane)

Electricity

- Energy Efficiency First
- Customer-Sited Generation
- Combined Heat and Power
- Development of Renewable Energy Resources
  - Solar
  - Wind
  - Biomass / Biofuels
  - Geothermal
  - Hydropower
  - Ocean (OTEC & Wave)
- Energy Storage
- Smart Grids
- Changes in Electricity Regulation
  - Delinking – from oil price
  - Decoupling revenues & sales
  - Customer Sited Generation

Bioenergy

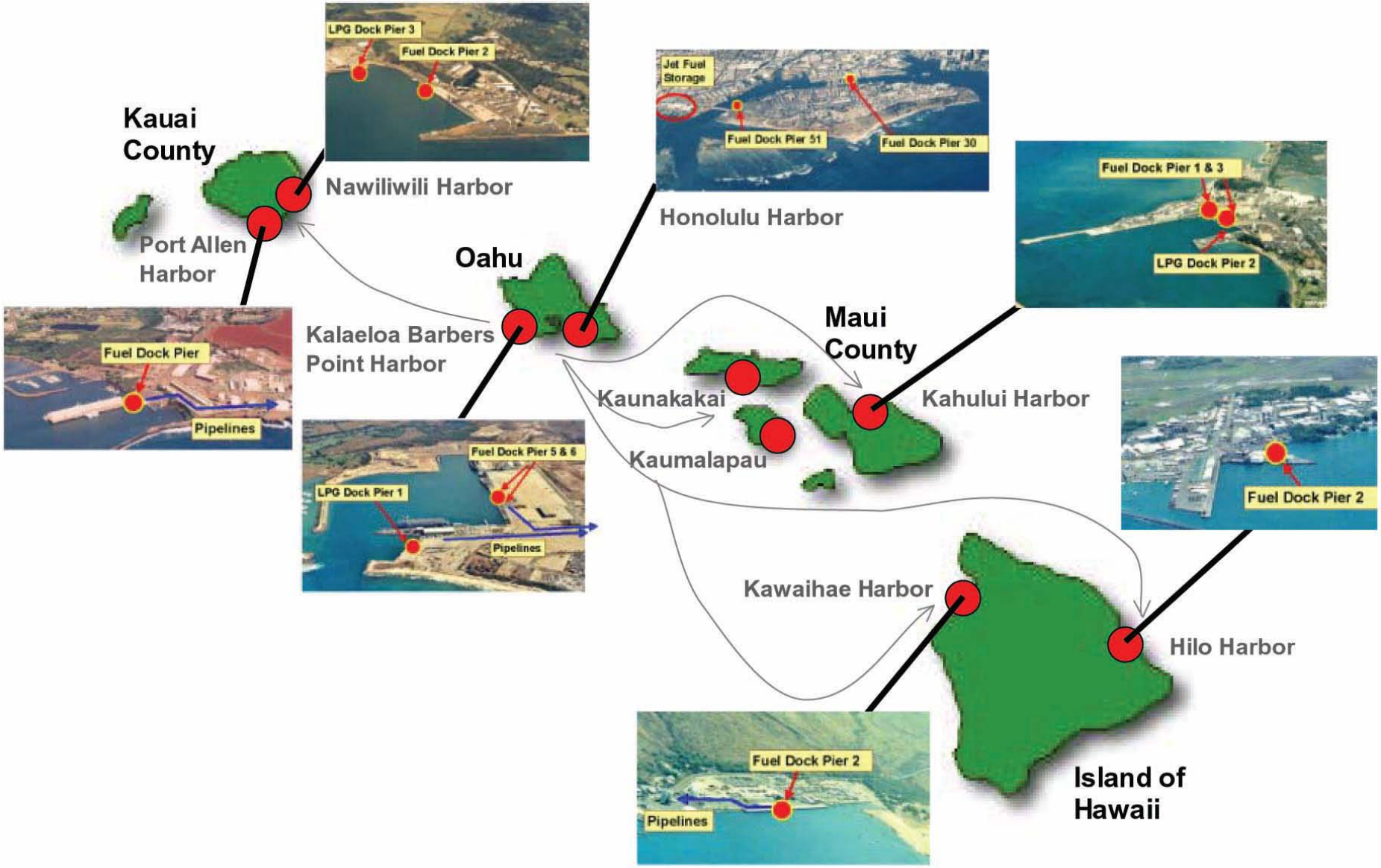
SUGAR CANE / GRASSES

WOOD

SOLID WASTE

OIL SEEDS

ALGAE


LPG Dock Pier 3
Fuel Dock Pier 2
Kauai County
Nawiliwili Harbor
Port Allen Harbor
Fuel Dock Pier
Pipelines
Jet Fuel Storage
Fuel Dock Pier 51
Fuel Dock Pier 30
Honolulu Harbor
Oahu
Kalaeloa Barbers Point Harbor
Fuel Dock Pier 5 & 6
LPG Dock Pier 1
Pipelines
Fuel Dock Pier 1 & 3
LPG Dock Pier 2
Maui County
Kaunakakai
Kahului Harbor
Kaumalapau
Fuel Dock Pier 2
Kawaihae Harbor
Hilo Harbor
Fuel Dock Pier 2
Pipelines
Island of Hawaii

Previous Bioenergy Studies

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
The State of Hawaii's Business Resource Site

HAWAII.GOV
STAY CONNECTED to Hawai'i State Government

ews Archive | Latest Additions | Career Opportunities | Site Map | search

mation resources » energy » renewable energy » biomass

Biomass

Biomass consists of growing plants or the remains of growing things. Examples include trees, grasses, agricultural and food processing wastes, manure, ocean plants, and even garbage.

Woodchips and other woody material can be burned to produce heat, steam or electricity (i.e. energy produced via combustion).

Farm products such as corn, sugarcane molasses, agricultural residues, or energy crops can be used to produce heat or used as transportation fuels (processes include combustion, fermentation, and gasification).

Vegetable oils may be converted into diesel fuel substitutes (via transesterification). Gases formed by waste materials and decaying biomass can also be collected and used as fuel (i.e. methane produced via anaerobic digestion).

Use of Biomass in Hawaii

INFORMATION RESOURCES

Economic Data
- Economic Data & Reports
- State of Hawaii Data Book
- DBEDT Library

Visitor Statistics
- Monthly Visitor Statistics
- Developing International Markets
- Oahu & Neighbor Island Highlights
- Annual Visitor

http://hawaii.gov/dbedt/info/energy/renewable/biomass

Biofuels Assessment

- Task 1 - Assessment of Existing Hawaii Biomass Feedstocks
- Task 2 – Crop Assessment
- Task 3 – Coordination with Hawaii State Agencies
- Task 4 - Report on the Potential for Biofuels Production
  - **Ethanol**
  - **Biodiesel**
  - **Biomass-Derived Hydrogen**

Rain Fed Dry Matter and Oil Yield of Crops Grown Under a Range of Soil Temperature and Moisture Regimes

Soil	Sugar cane (ton/ acre/ year)	Bana grass (ton/ acre/ year)	Euca lyptus (ton/ acre/ year)	Leu caena (ton/ acre/ year)	Oil Palm (gallons /acre /year)	Jatropha (gallons /acre /year)
Warm / Moist	23.8	21.5	7.8	8.8	226	114
Warm / Wet	28.6	26.8	11	8	390	180
Warm / Saturated		14.1				
Cool / Wet			9.9			
Cold / Wet		8.2	9.7	2		

From Table 5.2

Opportunities & Challenges for Biofuel Development in Hawaii

- Selection and development of new crop species
- Microalgae oil research and commercialization
- Research to improve existing crop yields and evaluate new crops
- Integrated “biorefinery” approaches that produce high value co-products
- Strategies to produce food/feed and fuel from common acreage
- Multidimensional approaches such as ecotourism or agritourism linked to sustainable bioenergy farms and processing facilities

Hawaii Bioenergy Master Plan Project

U.S. Department of ENERGY

DBEDT
STATE OF HAWAII • DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

HNEI
Hawai'i Natural Energy Institute
University of Hawai'i at Mānoa

Hawai'i Powered
Hawai'i Clean Energy Initiative

Hawaii Bioenergy Master Plan Project

- **Local knowledge, expertise, & input**

  ..as task leads, authors, and reviewers

  - ✓ Task leads & authors
  - ✓ Kickoff meeting, 5/08
  - ✓ Ag Conference, 9/08
  - ✓ Stakeholder meetings, 4/09
  - ✓ Surveys, email, website, review comments

Hawaii Bioenergy Master Plan Project

- Excellent Resource & Reference Material
  - ✓ 10 Issue Reports
  - ✓ Bioenergy Business Partner Survey
  - ✓ Bioenergy Partnering Database
  - ✓ Stakeholder Comments
  - ✓ Public Discussion

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Final Report

- **Volume I – Summary**
  - Executive Summary
  - Table of Contents
  - Part 1 - Overview
  - Part 2 - Perspectives on the Bioenergy Industry
  - Part 3 - Potential and Actions
  - Part 4 – Conclusion
- **Volume II – Issue Reports**
  - 2.1 Land and Water
  - 2.2 Distribution Infrastructure
  - 2.3 Labor Resources
  - 2.4 Technology
  - 2.5 Permitting
  - 2.6 Financial Incentives
  - 2.7 Business Partnering
  - 2.8 Economic Impacts
  - 2.9 Environmental Impacts
  - 2.10 State, County, &Federal Plans, Policies, Statutes, & Regulations
- **Volume III – Stakeholder Comment**
- **Resources on Website:**
  - Business Partnering
  - Current Catalogs
  - Bioenergy Business Model Catalog
  - Bioenergy Business Partner Catalog

The Road to

Locally Produced Food & Fuel

Fuel Distributors

- Blend biomass-based fuels with petroleum-based fuels.
- Ensure that fuels meet all Federal, State, industry, and manufacturer specifications.
- Communicate that fungible biomass-based fuels have the same properties and handling as their petroleum-based counterparts, and can be blended, transported, stored, and used in the same equipment.

Fuel Users

- Land and Marine: Use biomass based fuels alone or in blends with petroleum based fuels.
- Utility: Use biodiesels, bio-oil, and other biomass-based fuels as dispatchable power in support of other renewable energy sources; capture or provide CO_2 to algae producers.
- Aviation: Complete testing, demonstration, and certification for use in civilian and military aircraft.

Processing Facilities

- Small, distributed local facilities convert sugars, oils, and/or fiber to fuels (ethanol, biodiesel); co-products (feeds, fertilizers, electricity, etc.); and/or bio-oil (for refinement at central facility).
- Centralized Hawaii facility converts bio-oil to refined fuels – biomass-based diesel, jet fuel, gasoline.

Small Farms

- Identify opportunities to increase revenues or reduce costs via electricity, feed, fertilizer, by-products, or bioenergy / bio-oil feedstock production and application.
- Participate in crop trials and co-product testing when appropriate.

Large Farms

- Evaluate long-term business plans that include production of food, feed, energy, fuels, and co-products.
- Determine cost-effective scale(s) of production.
- Monitor changes in petroleum supplies and prices, fuel production technologies, crop yields, production and harvesting costs; and market(s) for product(s).
- When feasible, obtain financing; develop project(s); modify as necessary to capture new opportunities.

Seed Farmers / Ranchers / Other Producers

- Work with potential feed producers to evaluate and test suitability of co-products for local livestock and aquatic use.
- Identify opportunities to increase land utilization through co-production or intercropping.

Conduct Research & Demonstrations; Provide Information & Support

- Crops: Conduct crop trials to determine Hawaii yields; hybrids suited to various Hawaii conditions, i.e. grasses (cane, sorghum); oilseeds; tree nuts; algae; trees (eucalyptus; seedless leucaena; timber); other crops, especially those with food or feed potential
- Water: Research & demonstrate use of non-potable sources; demonstrate low-loss irrigation techniques; provide information to farmers.
- Land: Provide soil type, slope, rainfall, solar insolation, temperature, and other relevant information in GIS format and downloadable maps; research potential use of lava lands.
- Harvesting: Develop and demonstrate technologies appropriate for Hawaii.
- Processing and Fuel Production: Reduce technical risk through private- and government-funded research; develop co-product utilization technologies and markets.
- Information: Establish Hawaii bioenergy website; provide information on projects, funding, incentives.
- Coordination: Facilitate introductions and discussions between investors, project developers, landowners, funding agencies, researchers, consultants, technical experts, and public and private organizations; provide capability for public input and community outreach.
- Sustainability: Provide scientific data on crop, processing, and resource utilization and best practices.
- Analysis: Develop agricultural/bioenergy decision model, with current agricultural entities and various processing facility, biorefinery, and by-product scenarios included.
- Policy: support existing Hawaii biofuel and agricultural operations.

Support Agricultural Sector

- Land: Protect good agricultural land and provide long term leases and reasonable lease rents for farmers.
- Water: Maintain aging irrigation systems and plan and develop new systems. Ensure access to reliable, consistent and affordable water for agriculture.
- Energy: Address rising transportation, fertilizer, fuel, electricity, feed and other input costs through use of local resources.
- Labor: Develop programs to ensure agricultural labor availability and agricultural worker housing.
- Revenue and financing: Increase revenue (electricity sales; value from co-products); develop long term contracts to offset market volatility concerns.

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Hawai'i Clean Energy Initiative

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